THE EIGHTH GRADE

In these days of blood and iron, the man who talks of matters he knows nothing of is doubly intolerable. One listens eagerly to the laundress' mother, who was a peasant on one of the Kaiser's estates and knows well the service America has done for the immigrant from Germany; but one turns with weariness and disgust from the second-hand opinions of one's acquaintance and one's newspaper about the conduct of the war, the diplomacy of our Department of State, or the future of Russia. If one were but privileged to be as rude as he feels, what a deal of weariness he might avoid in ordinary conversation. Instead of permitting the chance-met acquaintance to emulate the loungers in the village post-office, settling the affairs of the world while they wait for the late train, one could say, "What do you read?" "I read," says he, *"The Chicago Tribune, The New Republic, The Literary Digest, The Public,* and *The Atlantic Monthly."* "Very well, then I know what you think. Is there any subject that you really know something about from first-hand experience? If you must talk, talk about that."

To afford opportunity for first-hand experience, to make plain how essential it is to observe and handle material, if one is to draw conclusions on material matters, is the function of the teaching of science from the teacher's point of view. There is no contention here that first-hand opinions in the realms of taste and of intellect are or are not superior in value; the writer wishes to submit that in any realm there is a difference in quality between the knowledge gained by one's own deduction and the knowledge gained by assent to authority. I believe that giving children much of this kind of opportunity makes citizens fit for democracy and capable of understanding and supporting it; while long training of the other sort makes a servile people, fit only to step into the gutter when authority in uniform clanks by. The teacher's endeavor, when choosing science work for the grade, should therefore be to present actual material and train children to draw independent conclusions.

The outline of the eighth-grade science work will show what material we present to the children. This material, we believe, has significance at their stage of development, and will, we hope, set their

minds actively to work. Most important, from our point of view, is the landscape of the Chicago area. In a former number of the Year Book, I have written at some length on the attitude of mind which physiography teachers believe develops from rich experience in reading landscape. (*Year Book,* Vol. IV., p. 56.) I need not repeat these opinions. Science teachers are agreed upon them. But I should like to speak of three factors which greatly aid the teacher in the science work in this grade. First of these is the mental attitude of the children. The outlines of the lower grades show that our children come to the eighth grade with a store of invaluable outdoor experience. They evince a gratifying bent for finding out reasons for themselves, calculated to make the teaching of physiography in this grade seem more like pointing them the way where, by due effort, they may appease their appetites, than like setting them an ungrateful task. To the class the work, beginning as it does with the making of a topographic map in the field and the reading and interpretation of topographic maps in preparation for field excursions, seems entirely new. But from every pupil entering our eighth grade from other schools, we have the wondering complaint that the others do this work better, because the complainant has "never had it before." What he sees his classmates in possession of is not knowledge of the topographic map, but a mental attitude. Their experience throughout their school life, in handling actual material, manifests itself in their eager relish of a novel task, before which the new pupil is more or less aghast. John's letter, a part of which follows, I insert, because it typifies this joy in working out a thing for oneself, which we believe we see in the children as a result of this year's science work. The letter was written two years after John felt the grade, after a summer spent in Massachusetts.

* * *

"I certainly appreciate your work in geology, physiography, etc. It enabled me to skip the physiography course at Lane, and has made every rock, ridge, or pond more interesting. This week I have been reading 'The Geology of Essex County,' by John Sears, of the Peabody Museum. As the book says, it covers every one-sixth of a square mile, first east to west, then west to east, north to south, south to north, northwest to southeast, etc., in great detail. With the book, and a large topographic map, with the rocks at surface colored, together with auto rides through the county, I got a pretty good idea of things, although I did get tangled up where the quartz-hornblende-diorite was cutting dikes in the hornblende-epidote-gneiss. From what I could make out, the county has first the pre-Cambrian

sedimentary rocks, which were bumped up into mountains two miles high by the intruding lava; that this lava was cut by more lava; that there were mountains cut by dikes, dikes by veins; that there was layer after layer of volcanic rock; that the land sank, the ocean covered it and formed thin sediments; that beaches were formed, now high and dry miles inland; then the land rose and the glacier came down from the north; scratches, drumlins, eskers, kames, were formed; and now the land is sinking. Trees may be seen far under water, and islands are smaller every day (more or less). The rivers are all drowned valleys, up which the tide runs. The book was a good deal too deep for me, but by reading 75% I understood 15% and will remember 5%. I wish I could find a book like that about every region I visit."

* * *

"Finding a book like that about every region one visits" is unfortunately not possible. But John's letter makes one hope that the year's work results in a belief in a changing landscape; an understanding of how land surfaces, by their materials, show their history, sea-bottom origin, emergence, submergence, etc.; and a power of first-hand observation and deduction. If it does so result, finding books is a secondary matter.

Some books, however, are needed through the year, and the second of the special aids to the teacher of eighth-grade science is the form of textbook we are working out. Of course, our primary text is the natural landscape. But during the winter this book is closed. A formal textbook is calculated to defeat the very purpose of the study, to substitute authority for original deduction. One wants to give the child the answer when he is eager with the question. The textbook answers questions before they are asked. The good teacher, of course, can conquer any difficulty, but the difficulty inherent in the use of a physiography textbook is so great that the writer has for some years tried to conquer it by avoiding it, by using no textbook whatever. The evil consequent upon this heroic remedy is obvious. The pupil has not material for reference and review such as he likes to have. Supplementary reading of great value is afforded by the *Illinois State Geological Survey,* especially Bulletins 7 and 11. We study about a hundred pages of these books with much profit. They can be used by a pupil to test the correctness of his conclusions, and are in so far good. But we are compiling a loose-leaf textbook, still far from complete, which will, we believe, have all the virtues and none of the vices of the regular textbook. Most of our lessons are reprints from the government survey papers, on representative areas.

When pupils have studied the topographic map of Donaldsonville, Mississippi, and have drawn a profile, and most of them are clear in their own minds that a river of this type flowing above the surrounding land is impossible, and that the government surveyors are having a joke at their expense, a lesson on the natural levees of the lower Mississippi is seized upon with avidity. The like is true after a study of the drumlins of Sun Prairie, or other interesting areas. Other sheets are mineralogy tables, or review lessons on the origin of common rocks. The sheets fit the children's portfolios, and are interspersed with their own maps, papers, and diagrams.

Mention of the children's portfolios recalls the third factor in making this teaching most agreeable to the teacher. It is the custom in our school for every child to keep all of his papers for the year in portfolios. It is also the custom for the teacher, each year, to make a portfolio of representative papers from each child. These papers are primarily for a record of the child's work, but they serve also as an inspiring source of information and interest for later classes. More than one pupil, trying to work out the meaning of the columnar section of Chicago, has been assisted by Marcel's explanation of the underlying works which he entitled *Story of the Underworld.* Ted left us some highly colored diagrams of an imaginary region in which every kind of rock appears, including a fabulously rich gold mine, occupying the lava-filled gravel-bed of an ancient river. He wrote a clear account of how all these phenomena came about, which has contributed materially to some boys' growing conception of Nature's slow, irresistible, impressive forces. Every paper contributed to the teacher's portfolio may be needed by some later class and merits proportionately earnest effort.

Besides these papers, we have such things as a series of large drawings of faults, copied from various government folios, and other diagrams. Last year's class made us a plaster model of Niagara Falls. The horizontal scale is about an inch to the mile, and the vertical scale about 10 times as great. When it was first brought upstairs this year, the class gathered close around it before school and plied the teacher with questions. They read the printed sheets about the region with the greatest eagerness, walking up constantly to the model to clarify some point about the glacier-filled course at St. David's, the old lake-bottom below Lewiston, Goat Island, the Gorge. Then they attempted to make a topographical map from the model. They had

already, at the very beginning of the year, surveyed a hill in Lincoln Park, and made a topographic map of it. They had used government contour-maps occasionally, drawing cross-sections, and interpreting the symbols; but the baffling difficulty of this task of making such a map from the Niagara model was illuminating to the teacher, who had thought that that part of the subject had been thoroughly taught. If the cast had rendered no other service than to show the teacher how she had overestimated her success in a piece of teaching, it would have been worth the labor spent upon it.

We found this model very useful also when we were trying to work out the topography of the Western Front. This study was based on Prof. Douglas Johnson's most interesting book, *Topography and Strategy of the Great War*. We made a large copy of his map of the Paris basin, and as soon as the class saw "the natural defences of Paris" and realized the topographical reasons for Germany's advance through the flat country of Belgium and France, they worked with keen intelligence upon a possible explanation of these five escarpments and the water-gaps through which all traffic to Paris must pass. The most difficult part of the reasoning in regard to a rising area of tipped strata comes, as physiography teachers know, when the pupil has to image the static condition of the upper course of a river during the period when the river is slowly sawing its way through a band of hard rock. The children's eagerness to understand anything connected with the war helped them over this difficulty, but they were also materially helped by study on the Niagara model of the area above the falls. Plainly, this part of the river is temporarily at base level. The class gave a morning exercise on the *Topography of the Western Front,* a stenographic report of which I insert here:

MORNING EXERCISE—THE WESTERN FRONT

Wednesday, April 10, 1918.

Alexis. Not only are we, and the peoples of twenty-three other nations doing all that is within our power to help the great ideal of democracy, but the sea, a million years ago, when it lapped its distant shores, rocking over what is today France, was bending its mighty power towards helping democracy. The enormous pressure that folded and contorted the rock, the majestic rivers that carved the land, all had their share in the great battle between autocracy and democracy. The reasons for this are to be told in what follows. Had it not been for the great resistance given by the Belgians at Liége, and the way in which the rocks lie in Northern France, the Germans would probably be in possession today of entire Europe.

You are now asked to come to a meeting of French generals, who will consult each other as to which way the enemy will be most likely to make its attack.

(Group of boys enter and seat themselves about a table, with a telegrapher at a desk near-by.)

First General (Charles). We are on the verge of war, and we have come to discuss how the enemy can get into Paris—how they will first advance on Paris. What is your view, general?

Second General (Preston). I think that a very probable way for the Germans to attack Paris would be through the second escarpment at Toul. They would do this, because their object is to take Paris as quickly as possible, before any other country can come to the aid of France. In order to do this, they will, of course, take the shortest route to Paris, which is through Toul, the distance being only 170 miles from there to Paris. Besides being the shortest route to Paris, Toul is also a very important railroad center, and it would be very easy to transport troops through Toul by the railways. Since the Franco-Prussian war, Germany has owned the city of Metz, and if she can capture the city of Nancy she will have two direct lines of march through Toul, so I do not believe the Germans would have a very hard time getting to Paris by this route.

Third General (Carter). As you say, it is only 170 miles to Paris from Metz. But even so, I do not think that the Germans would take this route. The reason for my saying this is that the fortifications around Nancy are very strong; it would mean a great loss of life if they should try to storm these fortifications. But instead, I think they would come up the Meuse river and attack Namur, and from there proceed up the river, even though the country is rough and difficult. When they come to Toul, they would have to come through Nancy, and the plan I am expecting would save them taking these two escarpments and they would be much nearer Paris. From the river Meuse they would then proceed to Paris by capturing Verdun.

Fourth General (Walter). I do not agree with you in this, General. In coming up the Meuse, the Germans would be going through Belgian territory. Therefore, if they are going to violate Belgium, instead of going by way of the steep escarpments, which are hard to ascend and very strongly fortified, they will cut across the southern end of Belgium, going around the northern end of the escarpments, which will bring them down in front of Paris. They will in this way go up the Meuse river only as far as Namur; they will plan to cut off the French army by surrounding it on all sides. In the meantime, they will try to send another army up through the northern part of Belgium and France and capture the seaports. This would not only enable them to have a good range on England, but also to keep other armies and supplies from coming by sea to help France or Belgium. After the French army is surrounded, it would be an easy task to capture Paris, so I think such places as Namur and Liége should be most carefully watched and the Belgians reinforced strongly if necessary.

First General (Charles). It is altogether improbable that they would do this, because I do not think there is a nation so low that it would risk its

standing in the world for a small military advantage. If they did go through Belgium, that would bring England into the war, and perhaps even America. And as for having them go through Belgium to the coast, it is impossible, as it is marshy and swampy in that region and heavy guns could not go through. Another reason is that a small army in Belgium could hold Germany for at least three days, so that England could get her forces together and stop the drive. But just the same, I would advise having strong forces at Nancy, Verdun, Liége, and Toul.

(The instrument on the desk ticks a message, and the operator hands a telegram to the general.)

General. Gentlemen: Germany has thrown away her honor and has declared war. They are coming through Belgium and are storming Liége.

(Exit generals to the defence of France.)

(Group of children on stage answering questions put by Edward.)

Edward. We are all interested, since the United States declared war on Germany, in the army and navy, perhaps more interested in the army and navy than in anything else. We are going to try to show you by twelve questions what the officers have to learn before they go over to France of the topography of the Paris basin, and we are going to show you how we think the Paris basin was formed. I will put the questions. You are to suppose that the pupils answering them are men in the Officers' Training camp.

First Question.—Imagine a rock surface covered through long ages by a shallow sea. Imagine changes in the temperature, depth, stillness of the water, and character of the incoming rivers.

William. Sedimentary rock would be formed, and the change of temperature would prevent or make coral. A rushing river coming into the sea would make conglomerate; the slower rivers coming in would make sandstone; and the very slow rivers coming into a shallow sea will bring down clay and lay it in the sea bottom, and make shale.

Second Question.—Imagine earth shrinkage, causing violent faulting and contortion of the rock, and imagine emergence of the rock in the east and gentle bowing to the west.

John. In case of rock contortion and gentle bowing in the west, a portion of the rock will project above the surface of the sea, and the softer rocks will be washed away by the rain water.

Third Question.—Imagine recession of the sea from the entire area. What would be the first cause of change?

Ruth. After the sea recedes, the rivers will be the first cause of change.

Fourth Question.—How long will these rivers work?

Barbara. The rivers will work until they cut down to the base-level.

Fifth Question.—What will be the character of the rivers at the close of this period?

Ruth. At the close of this period the rivers will be old; they will be slow and meandering.

Sixth Question.—Imagine a slow uplifting of the entire area. What will happen at the mouths of the rivers?

John. At the mouths of the rivers falls will be formed.

Seventh Question.—Where will the rapid cutting be checked, and for how long?

Margaretta. The rapid cutting will be checked when the falls reach a hard layer of rock, and then a slow cutting will continue until the falls have again reached a softer layer of rock when the cutting will be much swifter.

Eighth Question.—What will happen, meanwhile, below this point?

Ruth. Below this point, the rivers and their tributaries will have been cutting the surface down to the base-level.

Ninth Question.—What will be happening above this point?

Barbara. Nothing will be happening above this point, because the cutting is checked, and the rivers can only meander in their beds.

Tenth Question.—What will happen above the hard rock as soon as the river has sawed through and made a gap?

John. As soon as the river cuts a narrow gorge through the hard rock and hits the soft rock, it will cut much faster. It will meander around in this soft rock and tributaries will form and will cut away all the soft rock, until it has the same level as the river-bed as it cuts through the hard rock. In other words, it will hollow the entire area of soft rock out, leaving the hard rock as a great plateau. Then it will cut through the next layer of hard rock and repeat the action. That is, it will make a cliff, or escarpment.

Edward. This is what we meant when we said, "A million years ago the sea was working for the ideal of democracy." These escarpments have played a great part in checking some of the great German drives. At Verdun the escarpment near there probably did as much as the French army to stop the German drive. The topography of the land around Verdun will be explained a little later.

Elizabeth. The western front today starts in the northern part of Belgium, at Ypres, and goes straight south at the east of Lille, and then straight on down west of Amiens. Then it goes straight east to Verdun. It has been very hard for the German troops to take these escarpments, because the English artillery can mow them down before they can make any headway. They were able to get Lille because the hills were not so steep up there and they got up the escarpment before they were beaten back.

Caroline. One of the largest battles of the war was Verdun, and happened in 1916. The country around Verdun is a network of hills and valleys, very similar to the north shore of the Chicago area except on a large scale.

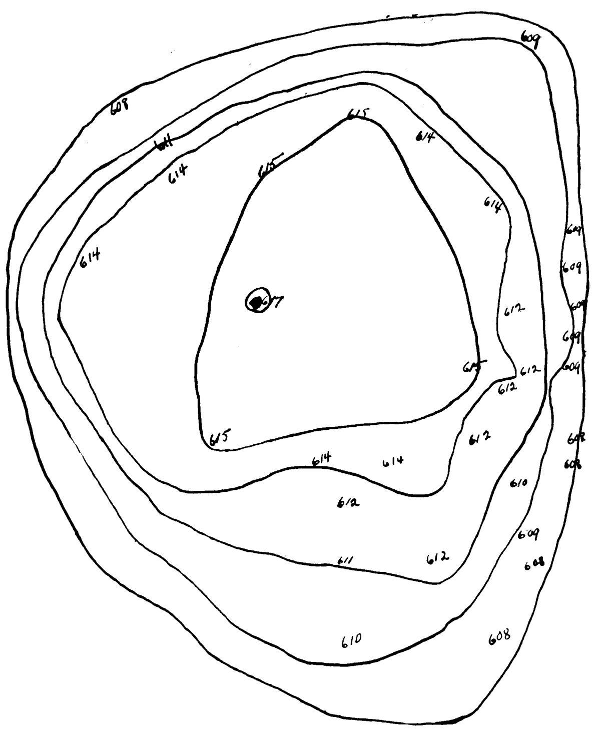
The Germans attacked three different times. First over the escarpment on the west of the Moevre. This attack was a failure, because the French had felt that it was necessary to command the hills surrounding Verdun instead of the city itself, and Moevre valley was heavily fortified. The Germans could only take certain cement government roads, and consequently, since the French had guarded the positions, the Germans could not move without heavy losses. For this reason this swampy area is called the blood-soaked plain of the Moevre.

Another way the net work of ravines and ridges helped the French was in the second attack, when the Germans tried to go over the escarp-

ment and cross the Meuse river. We do not know much about this, except that it also was a failure.

The third attempt, the Germans tried to go up the river to Verdun and capture it in that way, but this also was unsuccessful.

The reason that the Germans wanted Verdun was not only because of the military advantages, but also for the prestige, because they felt that if they were successful in this battle the war would be practically over, and they wanted the neutral countries, of which there were a great many (our own among the number), to come in and side with them. This battle shows how the topography helped the French, as it has in almost every large battle that has been fought.



TOPOGRAPHIC MAP OF HILL IN LINCOLN PARK
(Contour intervals 2 ft.; scale, 20 ft. to 1 in.)

From this year's portfolio, I take Margaretta's paper on *The Making of a Topographic Map,* which will, I hope be clear to succeeding classes. Before we mapped the hill, we had found the

SETTING THE PLANE TABLE

elevation of its highest part by measuring up from the lake, datum 581.

* * *

Now that we have the height of the hill, we are ready to work from it to find the elevation of various points, in order to make a topographic map. The instruments we use are as follows: The plane-table, which was made by some high-school boys, and consists of a drawing-board screwed to a tripod; a level, like a carpenter's level, with sights on it, so that another object of the same height may be sighted by looking through the hole in the first sight and moving the object until it is on the same level; a chain or tape about fifty feet long; a ruler; a pole, which is about six feet high, painted in red and white stripes, so that it can be well seen; a plumb-line; a compass; a paper and pencil.

We tack a sheet of paper to the plane-table, set our table up a short distance down the hill, level it and orient it. To level the table, we put the level on top of the drawing-board, and move the legs of the tripod in and out until the bubble of the level is in the middle. Then the level is placed at right angles to its former position and the table leveled in that direction also. To orient the table, a compass is laid on the corner the first time the table is set up, and a line is drawn north and south. Every time the table is set up thereafter, the compass is set on it and the table is turned so that this line still runs north and south. We worked in groups of about five children each, so that every one could have a chance to see and to work.

Now that our table is set up, we are ready to take the back sight. We put our pole on the bench-mark, the top of the hill. We look through

the sights on the level, and the girl at the pole moves her hand up and down until it can be seen on the thread of the second sight. The distance of the hand from the ground is then measured and if it is one foot, we know that the elevation of the sight is 618.5 feet, because our bench-mark is 617.5 and the sight is level with the spot on the pole, which is one foot higher. If when we drop our plumb-line we find that the drawing-board is three feet from the ground, and the thickness of the board and the level up to the sight is six inches, we know that the elevation of the point where the plane-table stands is 3.5 feet lower than the sight, or 615 feet. In order that we may put the dot on our paper, corresponding to this point, we must measure the distance and mark it to scale. We find the distance to be 30 feet. We use a scale of 20 feet to the inch. Our dot will therefore be 1½ inches away from the dot which represents the top of the hill. We put our ruler on the paper so that it points from the dot representing the bench-mark directly at the pole. Then the new dot is made, 1.5 inches from the bench-mark, and marked with its elevation 615 feet. We can now move our pole. Our next observations are easier, because we find the elevation of the spots where the pole stands instead of the spot where the plumb-line falls. We can move our pole and make many dots before we move the plane-table.

The groups all go in different directions, and after they have all covered their sections with dots, the papers are laid together with their center dots together, and the north and south lines parallel. Then, by means of transfer-paper, the dots are all transferred to one sheet.

Now that we have the dots all on one sheet, we are ready to draw the contour-lines. As the top of the hill is 617 feet and our contour interval is 2 feet, our first contour would be at 615 feet. If there are any dots at that elevation, we draw the line through them. We draw it half-way between the 616-foot dot and the 614-foot dot, and two-thirds of the way between a 617-foot dot and a 614-foot dot. In this way we draw our contours every 2 feet. Any one can see from this map the shape and size of this hill and which slopes were steep and which gentle.

* * *

These are war times. Teachers now more than ever may be thankful if their curriculum is elastic. Every subject—history, literature, music, mathematics—has a fresh appeal for pupils in the lurid light of the world war, and physiography not the least. River piracy caused the great Toul gap; the incised meanders of the Aisne cost the British army countless lives; the Moevre is blood-soaked on account of its impermeable clay; the Verdun region is like our North Shore; the map of the Champagne Front shows a bewildering mass of topographic detail, every line of which may have life and death significance. Boys and girls want to know everything about the war. The subjoined outline does not indicate the new emphasis that the

MEASURING THE ANGLE OF THE ANTICLINE AT THORNE CREEK

(Here we saw also a terraced river valley, showing a drop from the former base level)

MODELING A RIVER VALLEY IN THE SAND OF THE PLAYGROUND

(The model is to make clear three ways in which the flat of a flood plain grows, and two ways in which a meandering river changes its course. This outdoor modeling has proved itself very useful in clearing up children's images)

war gives to Physiography teaching. But it is an axiom of teaching that any subject should be approached through the children's interests. Their deep interest in the war must be used to obviate the jingoism, the hysteria, the poison of hatred that saddens their elders, by giving new images, new material for judging, increased power.

TOPICAL OUTLINE OF EIGHTH-GRADE SCIENCE

(a) Landscape Reading in the Chicago Area.—Excursions to Winnetka, Sag, Cragin and Galewood, Thorn Creek, end of Rose Hill bar, Summit, Worth. (*Year Book,* Vol. IV, p. 56.)

(b) Making of a Topographic Map of a Hill in Lincoln Park. (See Margaretta's paper).

(c) Study from the Topographic Maps.—About a dozen typical areas are studied, using the loose-leaf text to verify conclusions and correct mistakes.

(d) Use of Areal, Structural and Sectional Maps.

(e) Origin and Descent of Rocks.—Igneous rock and origin of the earth. Sedimentary rock and its origin from igneous rock. Mantle rock, mineral veins, organic rock. Metamorphic rock and earth-folding.

(f) Detailed Studies.—Disintegration, transportation, deposition, solution, precipitation, cementation, crystallization, and the part of each in rock-making.

(g) Work of Waves, Flowing Water, Winds, General Weathering, Vulcanism, Earthquakes, Diastrophism.

(h) Physical Properties of Minerals.—Hardness, luster, tenacity, structure.

(i) Specific Gravity.

(j) The Nature of the Hypothesis.

NOTE.—The work varies from year to year. The seventh-grade science plan is new this year and the incoming class will have covered topic (e) and thereby gained time for more advanced work in eighth grade.